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A State of the Environment Fact Sheet

Pollutants in British Columbia's Marine Environment

Introduction

A healthy marine environment is important to life on the British Columbia coast. The Pacific marine environment provides habitat for many species of wildlife: for example, the Fraser River delta is a vital bird habitat and major spawning and rearing habitat for several fish species. Indigenous peoples, such as the Haida, Kwakiutl, Nootka, and Salish, who have lived along the Pacific coast for over 7 000 years, have based their traditional lifestyles and spiritual values on the natural riches of the marine environment. Today most British Columbians live near the coast in the heavily populated lower mainland and southern Vancouver Island cities, and some earn their livelihood in coastal industries that depend directly on the productivity of the sea: an example is the fishing industry, which accounts for approximately 30% of the value of the entire Canadian fishery. Tourism and recreational activities centred around the rugged beauty and abundant wildlife of the west coast also contribute significantly to the provincial economy. These activities depend on a clean and healthy environment.

The concentration of urban centres and industries along the coast has created stress on coastal ecosystems, particularly around Vancouver (Map 1). Some of this stress is in the form of pollution. Municipal sewage, wastewater from pulp and paper mills, and tailings from mines contribute many of the pollutants. Other sources include authorized waste disposal at ocean dump sites, accidental spills from ships and from land-based industries, storm runoff from urban areas and farms, and the spills of fuel and cargo that occur during port and harbour operations.

The concentration of urban centres and industries along the coast has resulted in stress on coastal ecosystems

This fact sheet provides information about sources and effects of the pollutants that threaten British Columbia's fragile marine environment; it looks in particular at the persistent pollutants that are the object of much current research; and it describes some of the steps that governments and industries are taking to better control pollution. It summarizes the information presented in the first State of the Environment report, *Pollutants in British Columbia's Marine Environment,* which contains data for 1970–86, and supplements this with 1986–88 data and current information on programs and regulations.

D. Reede

Canadians must learn to balance economic activities, quality of life, and the environment

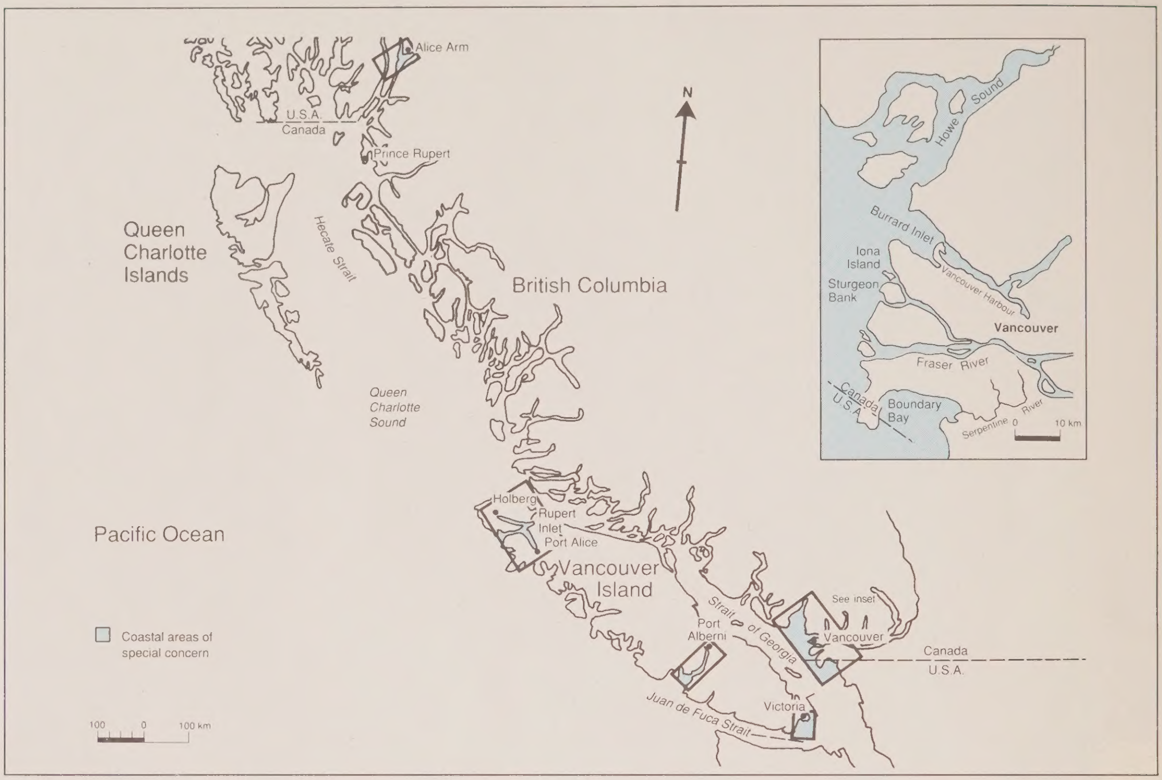
Pollution: sources and effects

Authorized disposal of wastes in marine waters

All around the world, people have believed that the ocean was large enough to be unaffected by the wastes of human societies. But in the past few decades, the wastes that end up in the sea have greatly increased in quantity and have come to include many new materials—from PCBs to plastic—that are not quickly broken down in natural systems. It is now acknowledged globally that disposal of wastes in the ocean must be controlled. Authorized disposal in British Columbia's marine waters is regulated by both provincial and federal legislation, including federal legislation controlling ocean dumping.

Waste discharge under permit—In 1988, 393 marine discharges were authorized by provincial

Map 1
The British Columbia marine environment, showing coastal areas of special concern



permits, up from 85 in 1973 (Figure 1). The majority of permits were issued to allow the discharge of municipal sewage, but the greatest volume of effluent was disposed of under the permits held by pulp mills. Currently, the three major types of waste discharged under permit are as follows:

1. Municipal and other sewage wastes. The most obvious impact of sewage on the ocean is bacteriological contamination of swimming beaches and shellfish harvesting areas, which must then be closed to protect public health. The transmission of disease through the consumption of molluscan shellfish (oysters, clams, and mussels) is of particular concern. These shellfish are filter-feeders and can concentrate contaminants, including bacteria and viruses, found in the marine waters. Consequently, federal water quality standards to measure the sanitary quality of molluscan shellfish waters are rigidly enforced.

   In 1988, bacteriological pollution from municipal waste discharges closed approximately 10 400 ha of intertidal area to shellfish harvesting. As Figure 2 shows, the overall trend is towards an increase in the area closed to shellfish harvesting. Other regularly monitored impacts of sewage discharges on the ocean include *nutrient enrichment*, which can stimulate the growth of plankton and may lead to a drop in dissolved oxygen levels available to fish and other marine life; *oxygen depression*, a reduction in dissolved oxygen due to oxygen-demanding substances in the effluents; the *accumulation of solids* on the ocean floor; and *effluent toxicity* *. These impacts are generally confined to the area immediately around sewage outlets or are not measurable. An exception was the occurrence of measurable oxygen depression in the water overlying Sturgeon Bank in the sensitive Fraser River estuary caused by the discharge of sewage from Vancouver's Iona Island sewage treatment plant through a 6-km channel. The impact on the estuary was mitigated in 1988 by constructing an outfall pipe extending out to deep water.

The most obvious impacts of sewage discharges to the ocean are bacteriological contamination of swimming beaches and shellfish harvesting areas

* "Toxicity" in this context refers to the inherent potential or capacity of a material (effluent) to cause adverse effects towards a test organism, usually fish. Used as a standard regulatory criterion, toxicity is determined by measuring the acute lethality of an effluent to a test organism over a 96-hour period in a bioassay test procedure.

Figure 1
The number of permits issued by the government of British Columbia authorizing the ongoing discharge of wastes to the sea is rising each year

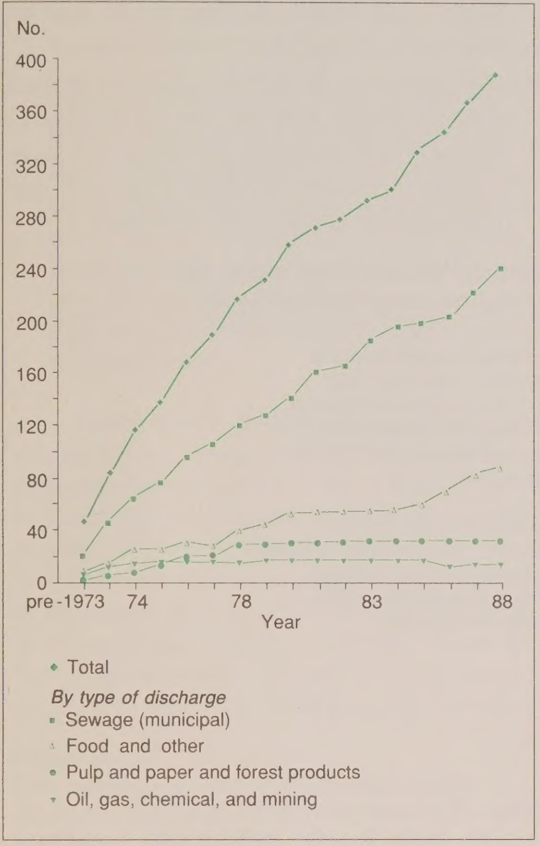
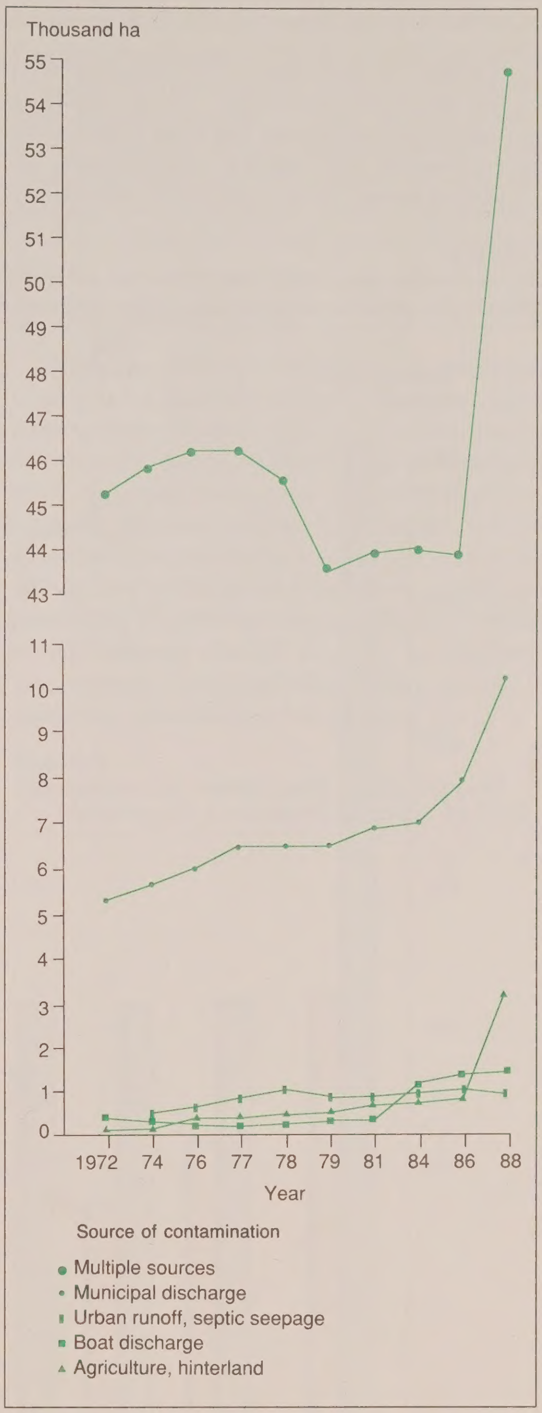


Figure 2
The area closed to shellfish harvesting in British Columbia due to fecal contamination has risen since 1972



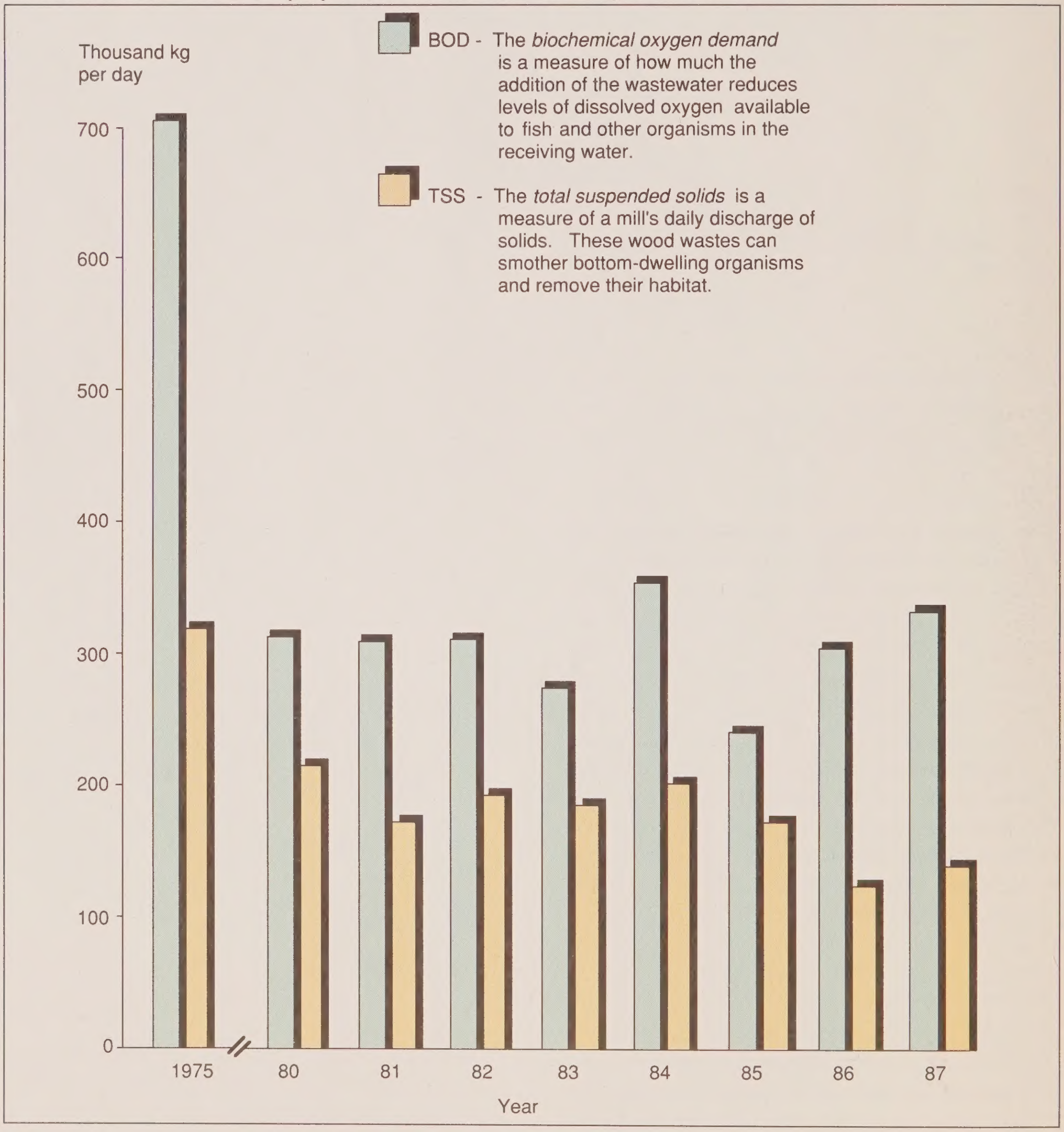
2. Pulp and paper industry wastes. Coastal pulp and paper mills discharge large volumes of wastewater to the ocean. The effluent contains chemicals from the pulping and bleaching processes, as well as wood fibres and other wood wastes. Under the conditions of their discharge permits, the paper companies regularly check toxicity, total suspended solids (TSS), and biochemical oxygen demand (BOD) in pulp mill discharges. Provincial and federal authorities also take samples for audit and regulatory purposes. The toxicity of the wastewater varies greatly between mills and from one test to the next at the same mill. It is difficult to determine trends in the toxicity of mill effluents using currently available data because of the different regulations that govern each site and the different ways in which samples are collected and tested. Certainly toxic effects on intertidal species have been reduced. This has been done by extending wastewater outlets away from the shore and its productive habitat and adding diffusers to spread the waste over wider areas. Solids discharged from pulp mills tend to fall to the ocean floor in an area

ranging from 0.5 to 9 km from the outfall. The solids smother bottom-dwelling organisms and remove their habitat. The extension of wastewater outfalls away from the shore has resulted in solids being deposited in deeper areas.

The BOD measurement provides information on the amount of oxygen that will be needed by marine microorganisms that break down various components (for example, wood sugars and hemicellulose) of the wood fibres and debris in the wastewater. The higher the BOD of the effluent, the less dissolved oxygen that will be available for plants and marine life. Effluent from coastal pulp mills has been shown to reduce the dissolved oxygen available to fish over an area ranging from 0.3 to 10 km^2.

Pulp mills achieved dramatic reductions in BOD and TSS between 1975 and 1980 in response to increased environmental awareness and more stringent regulations, but since 1980 no further reductions have been observed (Figure 3).

Figure 3
By two measures—BOD and TSS—the adverse effects of the effluent discharged daily from British Columbia's coastal pulp mills declined dramatically between 1975 and 1980



3. Mining wastes. Large quantities of tailings are discharged in the ocean at British Columbia's one operating coastal mine. The mine deposits 40 000–50 000 t of inorganic solids (e.g., tailings and waste rock) into Rupert Inlet on Vancouver Island each day, and these mine tailings extend 27 km from the discharge point. One effect of the tailings is to displace or smother bottom-dwelling organisms. In addition, researchers have studied this site and some abandoned coastal mine sites and have observed that levels of some trace metals in a variety of marine species at all the locations were higher than background levels; however, they were not at levels high enough to pose risks to the environment or to human health.

Ocean dumping—Federal legislation (formerly the *Ocean Dumping Control Act* and now the *Canadian Environmental Protection Act, Part VI)* administered by Environment Canada controls dumping of specific materials at sea. The ocean dumping control provisions ban, or limit the levels of, substances that can seriously harm the environment, including mercury, cadmium, oil and gas, high-level radioactive wastes, persistent plastics, and various other toxic materials. Disposal of substances is governed by a system of permits and is carried out at designated locations. The department issues 40–60 such permits a year, and most of the dumping occurs at six major sites in the waters off the lower mainland of British Columbia. As Figure 4 shows, the quantity disposed of each year varies substantially. The bulk of the dumped materials are from dredging operations. These ''dredge spoils'' alter the marine community covering up habitat and bottom-dwelling organisms. Other solids that are dumped, such as concrete blocks, can actually enhance habitat for certain species if properly placed.

Higher-than-background levels of some metals were found in marine species near various coastal mines

Marine spills

Marine spills are categorized as petroleum spills or industrial chemical spills. Petroleum spills make up about 80–90% of the incidents reported to Environment Canada. Spills of industrial chemicals, on the other hand, happen less frequently but release a greater volume of spillage to the ocean. Almost all of the industrial spills involve process-line or effluent-line breaks or other accidents at pulp and paper mills. Fish kills have resulted from these kinds of spills although there are generally no long-term consequences. Spilled oil affects many species, in particular, seabirds (see box on page 11).

Figure 4
The amounts of material dumped yearly between 1976 and 1988 under ocean dumping legislation vary enormously, although the number of permits issued does not vary much

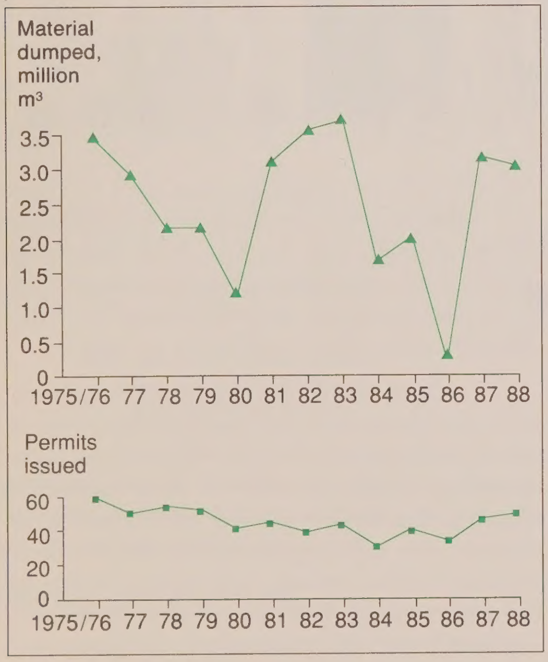
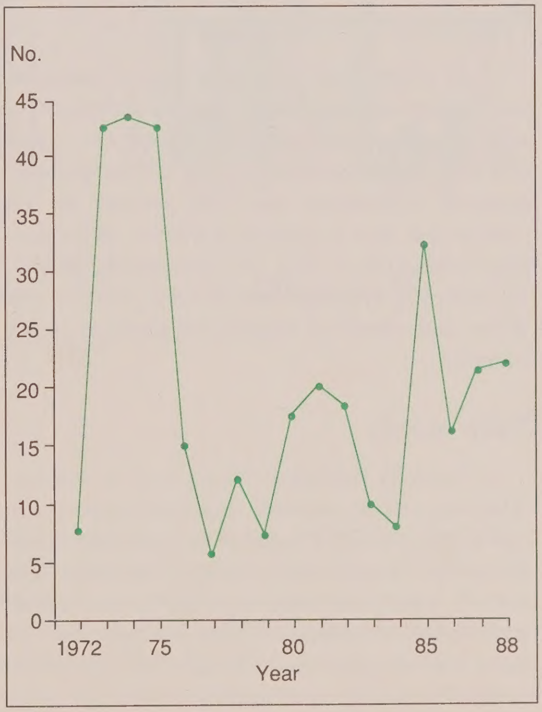


Figure 5
The number of marine spills involving over 1 t, including oil and chemical spills, 1972-88



Only a few of the 574 marine spills reported in 1988 involved over 1 t of spillage (Figure 5). Most reported spills are minor; the origin of almost half of them is unknown.

Non-point sources

Authorized disposal and accidental spills happen at specific geographic locations. But pollutants in surface runoff, seepage from septic systems, sewage discharges from boats, and polluted precipitation cannot be linked to specific locations. Pollutants from these diffuse, or non-point, sources include organic chemicals, trace metals, nutrients containing nitrogen and phosphorus, and bacteria.

In 1988, non-point fecal pollution (e.g., from agricultural areas) led to the closure of 5 376 ha to shellfish harvesting

The only effect of non-point pollution for which long-term trend data exist is contamination of shellfish areas by the diffuse release of fecal waste. In 1988, bacteriological contamination due to surface run-off containing the wastes of domestic and wild animals, seepage from septic systems, and release of raw sewage from boats necessitated the closure of 5 376 ha to shellfish harvesting; in 1972 the figure had been 1 037 ha (Figure 2).

A further 55 000 ha is closed due to multiple source pollution, which includes both point (sewage) and non-point sources. Much of this area is commercially non-productive shellfish habitat (e.g., Vancouver Harbour).

Persistent contaminants

In recent years there has been a shift towards the study of persistent pollutants

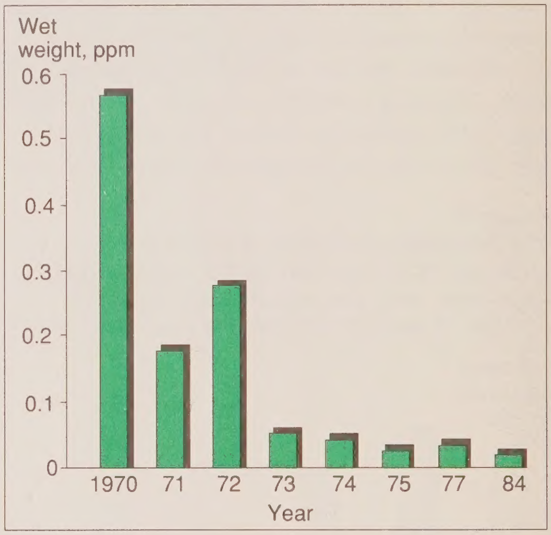
In recent years, the focus of environmental investigation has expanded to include the persistent pollutants. These include the trace metals, which have been measured since the early 1970s, and other persistent compounds that are present in the environment due to human activities: polychlorinated biphenyls (PCBs), chlorophenates, polycyclic aromatic hydrocarbons (PAHs), dioxins and furans, and tributyltin anti-fouling paints are some examples.

Trace metals

Naturally occurring metals such as arsenic, cadmium, copper, mercury, and lead become toxic to most forms of life if ingested or incorporated into tissues at sufficient concentrations. The trace metals that are most commonly reported in the marine environment are cadmium, lead, and mercury—all metals that have been shown to cause adverse human health effects. National Health and Welfare establishes guidelines concerning levels of trace metals and human health.

The acceptable limit for mercury (0.5 parts per million [ppm]) for fish and shellfish products intended for human consumption was exceeded during the early 1970s because of releases from a chlor-alkali plant in Howe Sound. Mercury levels have since decreased significantly in edible crab and other fish from the area (Figure 6) following the imposition of stricter environmental controls. Mercury levels from elsewhere along the coast are generally under the acceptable limit, although they may be exceeded in dogfish and certain bottom species, such as ratfish, which seem to be taking up mercury from natural sources.

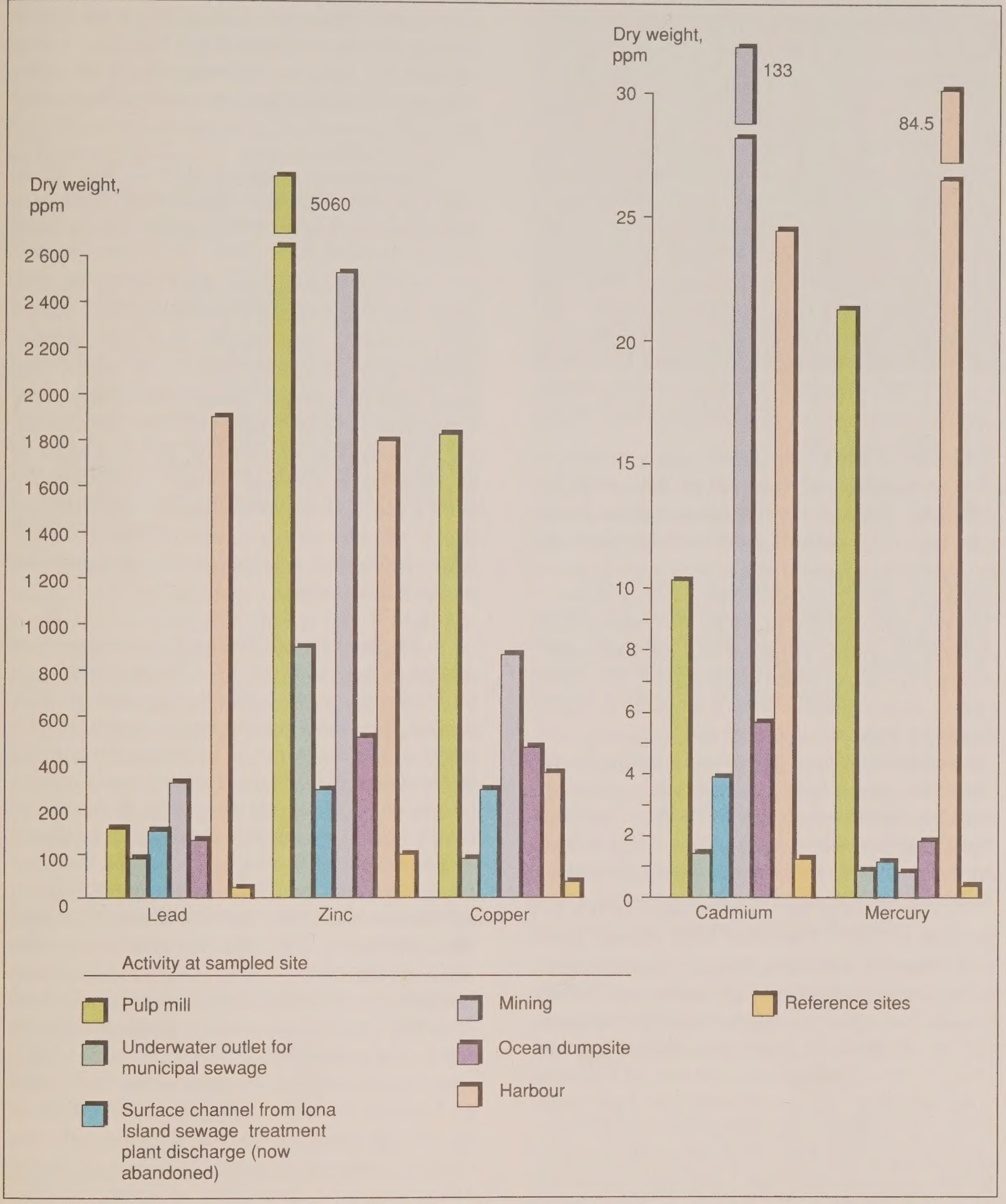
Figure 6
Mean mercury levels in crab tissue in Howe Sound, 1970-84. Levels decreased significantly between 1970 and 1973, following the imposition of much stricter environmental controls



Lead concentrations in various fish and shellfish are generally low, but high levels have been noted in areas associated with heavy industrialization around Vancouver and with mining activities. Cadmium levels vary considerably by species.

Levels of trace metals that exceed background levels have been observed in marine sediments at various locations (Figure 7). It is believed that these accumulations are the results of past and present industrial discharges, mining operations, aerial emission (for example, the lead in motor vehicle exhaust), marinas, marine traffic, urban runoff, ship building and repair facilities, ore concentrate loading docks, and sewer discharges. Whether these

Figure 7
Maximum trace metal concentrations in sediments between 1975 and 1985, at contaminated and reference sites on the British Columbia coast



accumulations are having any effect on British Columbia's marine environment or on human health has not yet been established.

Organic contaminants

Among the persistent organic compounds that have been increasing in the environment in the last half century and that have been detected in marine organisms are the chlorinated hydrocarbons,* such as PCBs, dioxins, and furans; an organotin compound, tributyltin; the chlorophenates; and the polycyclic aromatic hydrocarbons (PAHs). These

substances can cause biological damage at low concentrations; they persist in the environment; and they have the potential to accumulate in individual species (bioaccumulation) or through entire food webs (biomagnification), reaching the highest concentrations in top predators, including human beings.

In British Columbia, monitoring programs are expanding to examine the distribution, levels, and effects of these chemicals in the marine environment, but there are no published reports of long-term trends in the accumulation of persistent organic compounds in sediments and marine life. The Canadian Wildlife Service has a long-term program to monitor levels of organic contaminants in the eggs of Great Blue Herons foraging in the Fraser River estuary. This program has recorded a significant decline in most organic residues (pesticides, PCBs) over the past decade.

A long-term program to monitor levels of organic contaminants in Great Blue Heron eggs has recorded a significant decline in most residues over the past decade

Polychlorinated biphenyls (PCBs)—PCBs are a class of chlorinated hydrocarbons that have been used mainly as insulating and heat transfer fluids in electrical equipment and also in such products as plastics, inks, carbonless copy paper, and paints. The extreme stability of PCBs that makes them desirable for industrial applications also makes them a long-term hazard to the environment. They have caused adverse health effects in animals, including effects on reproduction. Some PCB mixtures are suspected of causing an increased incidence of liver cancer in humans but more evidence is needed to establish this conclusively. PCBs have not been manufactured in North America since 1978 but they are still in use in closed circuit electrical systems.

Surveys of PCBs in edible tissues of fish and shellfish in 1973, 1980, and 1985 showed levels well below the acceptable level (2 ppm wet weight, edible portion) established by Health and Welfare Canada for fish and shellfish for human consumption. No PCBs were detected in shellfish samples collected from growing areas that were at a distance from industrial sources of pollution. The marine sediments in these remote areas show levels ranging from less than 5 to 100 parts per billion (ppb). Levels are higher near pulp mills and harbours. A PCB spill of 800 L near Prince Rupert in 1977 resulted in the highest levels (75 000 ppm in the sediments) ever recorded along the coast of British Columbia. To prevent further dispersal and contact with aquatic organisms the sediments were capped to a depth of 6 m with leached hog fuel (wood waste) and a further protective covering of rock. Monitoring indicates that the contamination has been contained.

Long-term monitoring of Great Blue Heron eggs from the Fraser River shows a decline in PCB levels from 20 ppm in 1977 to about 5 ppm in 1988.

Dioxins and furans—Like PCBs, dioxins (polychlorinated dibenzo-p-dioxins) and furans (polychlorinated dibenzo-p-furans) are synthetic chlorinated hydrocarbons but unlike PCBs they have never been deliberately manufactured: they come into existence as byproducts of some manufacturing processes that use chlorine and as a result of the incineration of certain wastes. Their discovery in the Canadian environment and their extreme toxicity to test animals raises concern about the effect these chemicals are having on human beings and on the environment.

The discovery in 1982 of elevated levels of dioxins in eggs of Great Blue Herons foraging in the Fraser estuary prompted the Canadian Wildlife Service to expand its program to assess (1) the extent of contamination of fish-eating birds in the Strait of Georgia, (2) the changing levels of contamination over time, (3) the sources of dioxins and furans, and (4) the impacts of environmental levels on populations of fish-eating birds. The study has focused on the Great Blue Heron and its eggs at several colonies in the southern Strait of Georgia, although other species, including some cormorants, some diving ducks, and crows, have also been sampled. Even the least contaminated colony in the strait had higher levels of some dioxins than other fish-eating birds elsewhere in Canada. The highest levels were found in the heron colony at Crofton on Vancouver Island. Pulp mills are suspected as the most important source of these compounds. This program continues to assess the effects of dioxins and furans on the productivity of herons and other fish-eating birds.

Prior to 1987, there were few marine sampling programs on the Pacific coast that tested for dioxins and furans. Testing in 1986 did not detect dioxins in the edible portions of crab, fish,

* Chlorinated hydrocarbons (also known as organochlorines) are mostly synthetic compounds with unique chlorine-carbon bonds that are not readily broken down by natural processes.

and shrimp taken from Boundary Bay, Burrard Inlet, and Vancouver Harbour, but did detect levels of 2–3 parts per trillion (ppt) in other crab tissue. (Health and Welfare Canada has established a "regulatory tolerance" of 20 ppt in the edible portion of fish for the most toxic dioxin, 2,3,7,8 TCDD. When levels exceed the regulatory tolerance, the department recommends appropriate action, such as fisheries closures, to protect public health.)

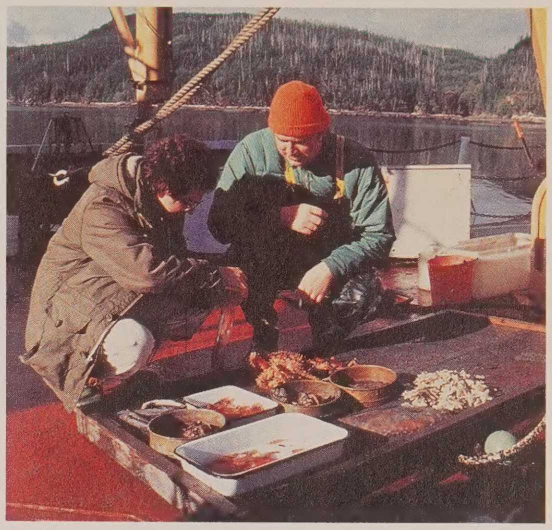
In 1988, sampling programs to determine the levels of chlorinated dibenzodioxin (CDD) and dibenzofuran (CDF) were set up because of concerns aroused by an Environmental Protection Agency study in the United States that had found elevated levels of dioxins and furans in the wastewater from five mills producing bleached kraft paper. Environment Canada, the Department of Fisheries and Oceans, and Health and Welfare Canada set up the sampling programs in conjunction with the ongoing investigations of contaminants in fish-eating birds conducted by the Canadian Wildlife Service.

These Canadian programs, like the American study, found elevated levels of dioxins and furans in fish and shellfish near some pulp mills that use the chlorine bleaching process. The levels in two areas were high enough to pose a human health hazard if the species were eaten regularly. As a result, on November 30, 1988, the fishing grounds near two mills in Howe Sound were closed to crab, shrimp, and prawn fishing, and the crab fishery near the Prince Rupert pulp mill was also closed. Sampling is continuing at these and other sites.

Chlorophenates—The forest industry in British Columbia has used fungicides containing chlorophenates to protect freshly cut lumber from sapstain and mould fungi. Chlorophenates and chlorophenols, which are breakdown products from the chlorophenate process, are toxic to fish and aquatic organisms. Chlorophenols have been detected in water, sediments, and marine life, particularly near forest industry operations.

Initial testing in 1978 found that the highest levels of chlorophenols in animal tissue were in the livers of sculpins, whereas levels were generally very low in edible crab tissue.

The toxicity of chlorophenates was demonstrated in 1984 when 45 000 L of chlorophenol were spilled and entered Vancouver's Hyland Creek, the Serpentine River, and the waters of Mud Bay. The spill had its greatest impact on Hyland Creek where 5 000 fish died. In the ocean the spill made much less of an impact and concentrations in the water were undetectable within 10 days.


Neil Holman

Collecting biological samples is one way to monitor marine environmental quality

Chlorophenate usage in Canada is under review and many forest companies have stopped using the compounds. Monitoring programs are assessing whether environmental levels are dropping as a result of reduced usage.

Tributyltin anti-fouling paints—The organotin compounds have developed into important industrial commodities in the last 40 years. One of them, tributyltin (TBT), is used in anti-fouling paint, which is applied to the hulls of ships to discourage the growth of marine organisms. It is known to be toxic to larval forms of marine life and to cause shell thickening and stunted growth in oysters.

Fishing grounds near some pulp mills that use the chlorine bleaching process were closed due to levels of dioxins and furans in shellfish

Fish nets treated with TBT installed in a coastal bay in British Columbia caused classic effects of TBT poisoning in oysters. As a result, TBT has been banned as a net anti-foulant at fish farms.

At 265 sites examined in Canada between 1982 and 1985, the 10 with the highest concentrations of TBT were in Vancouver Harbour. Studies are continuing to evaluate the levels of TBT contamination in water, sediments, fish, and shellfish in areas of heavy boat traffic.

Polycyclic aromatic hydrocarbons (PAHs)—Polycyclic aromatic hydrocarbons occur as a component of the complex mixture of hydrocarbons that

constitute petroleum and as products of combustion. Some forms of PAHs have been shown to cause an increased incidence of some forms of cancer in people and animals.

These volatile compounds have always been produced by fires but in much smaller quantities than are released by today's widespread fossil fuel combustion, aluminum smelting, and refuse burning; they reach the ocean predominately in polluted rain. Other sources of PAHs in the ocean are the weathering of creosote-treated wood products used in the construction of docks and wharfs, and oils and grease in storm runoff and from sewer outlets.

Benzo(a)pyrene is the most carcinogenic PAH, its levels are very low (0.9 ppb) or non-detectable in commercially harvested shellfish from British Columbia. However, levels are higher in harbour areas and are suspected of causing the liver lesions found in English sole in Vancouver Harbour in a 1985-87 study by Environment Canada.

Environmental monitoring

Current understanding of the state of the B.C. marine environment is based chiefly on short-term monitoring of localized pollution problems

Current understanding of trends in the quality of the marine environment of British Columbia is largely restricted to the results of short-term monitoring of localized pollution problems. Existing monitoring programs show that recovery from many local problems has occurred: examples include the reopening of shellfish harvesting beaches around Parksville and Qualicum on Vancouver Island that were closed due to fecal contamination; recovery of intertidal habitats in the vicinity of many coastal pulp mills; removal of sewage effluent from the sensitive Fraser River estuary; and recovery of dissolved oxygen levels in Wainwright Basin and Porpoise Harbour, near Prince Rupert. Local success with certain types of pollution notwithstanding, more long-term monitoring is needed before trends in the *overall* environmental quality of the British Columbia coast will become clear. Certainly there is no evidence of generalized coastal pollution as measured by indices such as declines in commercially important fish stocks, changes in breeding and migratory habits of seabirds, or human illness resulting from consumption of contaminated seafood. However, subtle changes, such as changes in the biology (e.g., reproductive processes) of a species, and long-term environmental changes have generally not been measured.

Another limitation of past monitoring programs as a guide to overall trends is that they have concentrated on the conventional pollutants (the trace metals, solid wastes, nutrients containing nitrogen and phosphorous, bacteria, and effluent toxicity) and do not measure environmental levels of persistent organic pollutants.

Environmental priorities

Environmental monitoring programs have identified several marine pollution problems. Domestic sewage has been responsible for the closure of many shellfish areas. Local fish populations have been affected by depressed oxygen levels in some areas. Temporary fishing bans have been required in Howe Sound (mercury contamination), Boundary Bay (chlorophenate spill), and Porpoise Harbour (PCB spill). Dioxin contamination has been found in Great Blue Heron colonies and in certain fish species. The latter resulted in the recent closure of some fisheries in Howe Sound and near Prince Rupert. The incidence of liver lesions in English sole from Vancouver Harbour is the latest warning of pollution in the marine environment.

In response to these and other pollution threats, governments and industry are taking steps, some of which are listed below, to better control marine pollution.

1. Environmental monitoring programs by the federal and provincial governments will continue to assess the extent of dioxin pollution near pulp mills.
2. New federal and provincial regulations have been announced that will require pulp mills to make significant reductions in the levels of recently identified dioxins, furans, and other chlorinated organic compounds in their releases. The federal regulations for the conventional pollutants are being revised to apply to all mills in Canada.
3. The provincial government has announced that secondary treatment of effluents will be required at all pulp mills to further reduce BOD, TSS, and toxicity.
4. In response to a growing aquaculture industry and tougher Canadian standards, Environment Canada is significantly expanding monitoring programs that assess pollution in shellfish-growing areas.
5. Several municipalities and regional districts are developing management plans to better control all liquid wastes.

The effects of an oil spill

The fragile nature of the British Columbia coast was underscored in 1988 when a barge, the *Nestucca,* spilled 875 000 L of Bunker C oil off the coast of Washington. From there the prevailing currents and sea conditions carried some of the oil north into Canadian waters. The spill, the largest in British Columbia's history, affected 150 km of its coastline, of which a total of 2 km was heavily oiled. The heavily oiled sections included popular tourist beaches and tidal pools in Pacific Rim National Park and the shorelines of six provincial ecological reserves.

Approximately 3 500 dead seabirds were found in British Columbia and 9 000 in Washington. Considering those that sank or were not found, the Canadian Wildlife Service estimates that 20 000 to 30 000 birds died. Shellfish harvesting for crabs, clams, mussels, and gooseneck barnacles was banned after the spill, and a more lengthy closure was imposed on crab fishing due to oil deposition on the bottom.


Keith Hebron

Cleaning up an oil spill on the west coast of Vancouver Island

Although clean-up of beaches was as thorough as possible, oil residues were expected to remain at least through one annual cycle of beach erosion and deposition. Studies continue to assess the long-term effects of the oil on fisheries, seabirds, and marine mammals.

6. Government experts and researchers are studying Vancouver Harbour and will report on the types and distribution of contaminants in sediments and fish and recommend appropriate pollution control and mitigation measures.

7. The provincial and federal governments are developing water quality objectives for various near-shore marine uses.

8. Environment Canada is developing guidelines that specify permissible levels of PAHs and dioxins in dredged sediments that may be disposed of at ocean dump sites, under the provisions of Part VI of the *Canadian Environmental Protection Act.*

These initiatives will result in local improvements in marine environmental quality and shed light on the fates and effects of chemicals and other pollutants in the marine environment. Long-term monitoring, strategic planning that harmonizes potentially conflicting uses of the coastal zone, and sound environmental management practices must be implemented to ensure that in the process of solving some pollution problems we do not end up creating others.

Long-term monitoring, planning that harmonizes potentially conflicting uses of the coastal zone, and sound environmental management practices are needed

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For further information

Supplementary information on marine environmental quality in British Columbia may be obtained from the following address:

Environment Canada
Communications Directorate
Kapilano 100—Park Royal
West Vancouver, B.C.
V7T 1A2

Information on State of the Environment Reporting may be obtained from the following address:

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